PATENT SPECIFICATION

482,634

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COMPLETE SPECIFICATION

A System of Protection for Liquid-insulated Electrical Apparatus

I, MAX BUCHHOLZ, of German Nationality, of Amalienstrasse 1, Kassel, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

It is known to protect electrical apparatus with insulating liquid by devices which are set in operation directly or indirectly by the action of gases of decomposition and vapours liberated, and also by air, due to internal faults and over-loading of the apparatus. Such protective devices are herein referred to as gas-protection devices and serve to cut out the apparatus in question under such conditions of fault or over-loading or to warn the attendant by optical or acoustic signals. As indicative of the prior art reference is made to the prior Specification 293,705.

The use of separate thermal detectors for the protection of electrical transformers is also known; see the prior Specification No. 273,701.

As the result of experimental research I have found it possible to combine in one and the same unit a gas-protection device and a thermal detector.

The present invention thus consists in liquid-insulated electrical apparatus incorporating protective means within a casing of the apparatus including a detector mechanically operated by gases or vapours or air and also separate detector means responsive to changes in temperature, each of said protective means being adapted to operate signalling or switch devices.

The detectors responsive to changes of temperature, or so-called thermal detectors may be expansion bodies such as gas-filled or liquid-filled capsules, or spirals or bands, for example, bi-metallic spirals or the like.

According to one example of construction, the expansion body is constituted by one or by a battery of gas-filled or liquid-filled capsules operatively connected with a float of the mechanically operated detector.

In another example of construction one end of a bi-metallic spiral is connected with a float, and the other end is connected with a mercury contact tube.

The expansion body may also actuate a shutter disposed in the path of flow to the mechanically operated detector and arranged, after a certain angular rotation, to entrain a float of the mechanically operated detector.

In a modification the expansion body is operatively connected with a rockable base-plate of a chamber superposed on the transformer casing.

The thermal detector may be arranged to control an obstacle in the path of flow to the mechanically operated detector, actuating, for example, a slide valve fitted to the pipe traversed by the insulating liquid.

In all the constructions contemplated the thermal detector can influence an optical signalling device the arrangement of which is particularly suitable, where the two detectors utilise the same switch arrangements.

Finally, the sensitivity of the mechanically operated detector can be rendered dependent on the pre-loading of the transformer by heating the thermal detector in manner known per se, for example, by a winding the heating current of which depends on the strength of the loading current of the transformer.

In Figs. 1 to 9 of the accompanying drawings there are illustrated several embodiments of the invention.

In the constructions according to Figs. 1 to 7 the protection devices are fitted within a pipe traversed by the liquid, for example, within the pipe which connects the transformer vessel to an expansion vessel.

Fig. 8 illustrates a protection device to be superposed on the transformer vessel.

Fig. 9 shows the assembly of the so-called gas-protection float, a bi-metallic spiral and a mercury contact tube.

Referring to Figs. 1 to 7, there is mounted in manner known per se within the pipe 1 through which the oil flows a float 2 pivoted for movement about the axis 3; in a chamber 4 open to the pipe 1 there is mounted a float 5 pivoted for

rocking movement about the axis 6.

As is understood, the float 2 in the pipe 1 comes into action in the event of violent agitation or ebullition in the insulating liquid which is caused by the generation of gas in the case of serious faults in the transformer.

As is also understood, the float 5 in the auxiliary chamber 4 falls with the oil level when as a result of minor faults gas accumulates in the chamber 4. Secured in known manner to the float 2 is a mercury contact tube 7 which closes a relay circuit when the float falls. The floats are prevented from excessive counter-clockwise movement by stops 27.

Besides the gas-protection floats in the pipe 1 there is provided a thermal detector which in the example of construction in Fig. 1 consists of a bi-metallic spiral 8 and a mercury contact tube 9.

While in the example of Fig. 1 the two contact tubes are connected to separate leads 10 and 11, in the construction according to Fig. 2 there is only one double lead 11, as the two detectors operate the same relay circuit.

In the constructions according to Figs. 3 to 6 and 8 the thermal detectors employ the same contact devices as the gas protection means.

As a thermal detector, in the example according to Fig. 3, there is employed a gas-filled capsule 12 which expands with rise of temperature and thereby rocks the float 2 about the axis 3 so that it engages the contact 14.

In the example according to Fig. 4, as will be best understood from consideration of Fig. 9, one end of a bi-metallic spiral 8 is connected with the float 2 and the other end of the spiral is connected with the mercury contact tube 15.

In the construction according to Fig. 5 the expansion body 12 rocks a shutter 16 about the axis 3 and thereby varies the resistance to flow within the pipe 1. From a certain angular position of the shutter 16 the float 2 is entrained so as to engage the contact designated 14 in Figs. 1 to 3.

In the example according to Fig. 6 an optical signal device is actuated mechanically at the same time by the expansion body 12. The signal device includes a circular disc 17 which is provided with horizontal slots and behind which is displaced a disc 18 provided with horizontal coloured lines corresponding to the breadth of the slots.

According to Fig. 7 the thermal detector influences a slide valve 19 so as to open further the passage for insulating liquid to the float 2 with a rise in temperature. When the permissible maximum temperature is exceeded, the contacts 20 connected to the slide valve are bridged by the yoke 21 whereby a relay circuit is operated.

In the example of Fig. 8 there is superposed on the transformer vessel a chamber 22 having a base-plate 24 rockable about the axis 23. The plate 24 is lifted by the evolution of gas so that the obliquely disposed contact tube 7 will operate a relay circuit. The plate is also lifted by the expansion body 12 as the temperature rises. The vent valve 25 permits escape of gas or vapour from the chamber 22.

In Fig. 8 there is shown wound around the expansion body 12 a heating coil 26 which is disposed, for example, in series or in shunt with the transformer winding.

In the examples of construction according to Figs. 3 to 6 the float is tilted by the thermal detector through an angle which is greater the higher the temperature rises. Consequently, the mechanically operated detector operates the more rapidly the higher is the temperature of the transformer.

The mechanically operated detector may also be made dependent on the loading current of the transformer, by the provision of a heating coil as in the example of Fig. 8. With the arrangement of such a coil the said detector will respond the more rapidly the larger is the loading current.

In the examples of construction according to Figs. 3 to 6 in which the two detectors have the same contact means it cannot be ascertained in the event of fault which protection device has responded. Therefore, according to the invention, there is used optical signalling means represented in the example of Fig. 6. In case in the event of a fault the slots in the signalling disc show for instance a single colour, it may be recognised therefrom that the transformer has exceeded the permissible maximum temperature and that therefore the temperature-responsive detector means has responded. As is understood, in lieu of the signalling device illustrated there may be employed any other type of mechanically or electrically operated signalling device, as, for example, one with droppers or flaps.

In the examples according to Figs. 1 and 7 in which the two detectors actuate separate relay circuits, the above described optical signalling means is not absolutely required.

Obviously also in lieu of the floats other responsive means of any type may be employed.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to

be performed, I declare that what I claim is:—

(1) Liquid-insulated electrical apparatus incorporating protective means within a casing of the apparatus including a detector mechanically operated by gases or vapours or air and also separate detector means responsive to changes in temperature, each of said protective means being adapted to operate signalling or switch devices.

(2) Apparatus as claimed in claim 1, in which the detector responsive to changes of temperature is an expansion body such as a gas-filled or liquid-filled capsule, or a spiral, for example, a bi-metallic spiral.

(3) Apparatus as claimed in claim 2, in which the expansion body comprises a single capsule or a battery of gas-filled or liquid-filled capsules operatively connected with a float.

(4) Apparatus as claimed in claim 2 in which one end of the spiral is connected with a float and the other end with a mercury contact tube.

(5) Apparatus as claimed in claim 2, in which the expansion body actuates a shutter located in the path of flow to a gas-responsive float, which shutter entrains the float after a certain angular movement of the shutter.

(6) Transformer apparatus as claimed in claim 2, in which the expansion body is operatively connected with a rockable base-plate of a chamber superposed on the transformer vessel.

7. Apparatus as claimed in claim 1, characterised in that the detector responsive to changes of temperature controls an obstacle in the path of flow to the mechanically operated detector, for example, a slide valve fitted within a pipe traversed by the liquid.

8. Apparatus as claimed in any of claims 1 to 7, in which the detector responsive to changes of temperature also actuates an optical signalling device.

9. Transformer apparatus as claimed in any of claims 1 to 8, in which the detector responsive to changes of temperature is heated by a coil the current flowing through which is dependent on the loading current of the transformer.

Dated the 26th day of February, 1937.

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Fig. 1

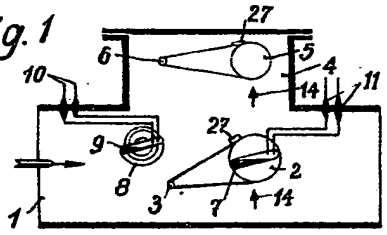


Fig. 2

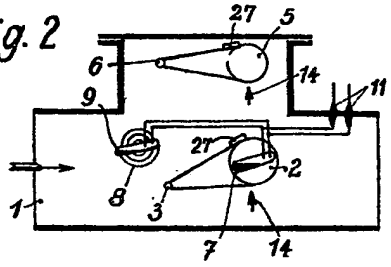


Fig. 3

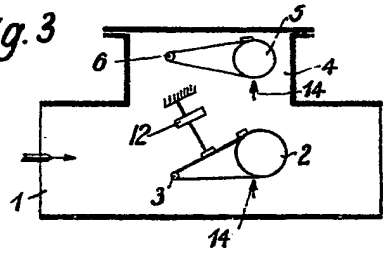


Fig. 4

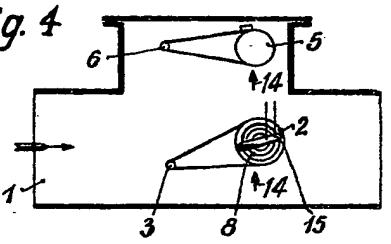


Fig. 5

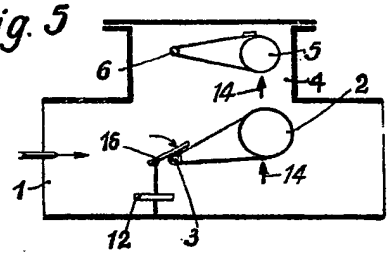


Fig. 6

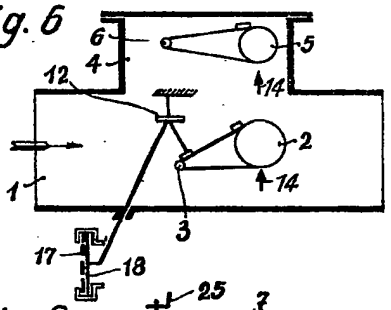


Fig. 7

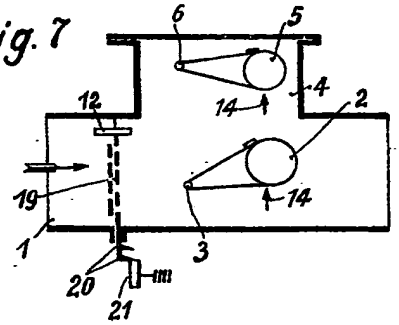


Fig. 8

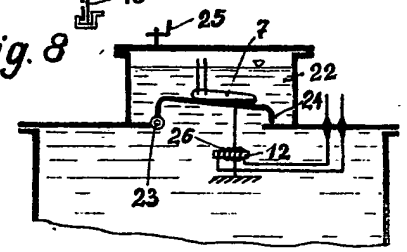
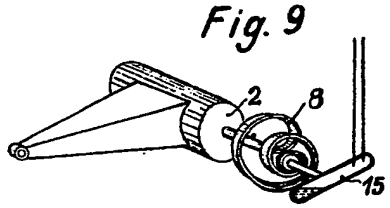


Fig. 9



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